been shown by the writer that the full effect of the current can only be obtained by one lamp on a short circuit, and that when adding to the lamps by inserting more of them on the same circuit, or on a circuit so that the current is subdivided, the light emitted by each lamp is diminished in the one case by the square, and in the other case by the cube of the number of lamps so inserted. Dr. Siemens maintains also the concentration of the power on one light, but other experimenters are endeavouring to partially multiply the light. For instance, M. Rapieff, in the *Times* office, very successfully distributes six lights about the office, and Ladd and Co., with the Wallace form of machine, also distribute six lights over the Liverpool Street Station. Although there is undoubtedly a loss of power in this distribution of the lamps, there may be an advantage in such distribution in cases like printing offices and railway stations. A successful experiment has been made by the British Electric Company in lighting up some of the stations of the Metropolitan Railway Company, and the India Rubber and Gutta Percha Company have been successful in lighting up the London Bridge station of the London Brighton and South Coast Railway Company. In all these cases we have scarcely emerged from the sphere of experiment. The electric light has not yet been permanently introduced on any large scale. Many are trying it, many are captivated by the brilliancy of the light, and many in their eagerness to keep up with the spirit of the age, are introducing it, as, for instance, the London Stereoscopic Company, and the Messrs. Nichols, the clothiers in Regent Street, where, however, the light does not appear to give very great satisfaction through its fluctuation.

We were led to expect very much from the experiments of Mr. Werdermann, but his attempt to subdivide the light seems to have subsided, for we have heard nothing of it for some time past. Again, we have heard no more of M. Arnaud's discovery, and the accounts that reach us from America of the doings of the Sawyer-Mann light, and of the supposed discoveries of Mr. Edison, are unworthy of attention.

The present state of the electric light question may therefore be said to be a tentative one, and the gas companies are with much enterprise now giving their retort courteous by showing that they are in a position—if people choose to pay for it—to give quite as powerful a light as the electric light; and, let us hope, before long that it will be quite as perfect. There can be no doubt that the use of electricity for the production of light is a very wasteful as well as a costly process, for the energy that is generated in the machine is not all consumed in the lamp, but is proportionately distributed over the whole circuit. It is therefore not utilised only in the place where it is wanted, as in the case of gas. If we are using a certain amount of energy in an electric lamp to light a street, we are wasting as much if not more energy in the street in maintaining the current to produce that light.

There are three points which all electric lights for general purposes should be required to attain. The first is a brilliancy far exceeding that of any known lamp; the second is a durability greater than that which would be required for night operations in England; and the third is absolute steadiness, to enable work to be conducted without affecting the eyes. There is no electric light that has yet been introduced which supplies us with these desiderata.

W. H. PREECE

THE "NOVUM ORGANUM"

Bacon's Novum Organum. Edited, with Introduction, Notes, &c., by Thomas Fowler, M.A., Professor of Logic in the University of Oxford. (Clarendon Press, 1878.)

THE writings of Lord Bacon, and especially the "Novum Organum," possess a fourfold interest. They have a direct bearing upon the history of philosophy, literature, logic, and physical science; and whatever estimate we may form of their influence upon each of these branches of knowledge, we think that few will fail to admit that Bacon threw a bridge over that vast and deep gulf which separates the ancient from the modern modes of thought, and directly opened a way to our present philosophy and science. Those who would make him the Founder of a sect, the Inventor of induction, or the Father of experimental philosophy, know nothing of his writings. Many had written against Aristotle before his time, many had advocated the collection of positive facts, and the application of a just induction, but they had offered on their part no system which could replace that of Aristotle. When the Scholastics began to abandon their leader, some took refuge in the meagre philosophies of Ramus, of Telesius, of Aconcio, of Nizolius, of Campanella, and of minor men. But when Bacon gave to the world a vast and definite system, and for the first time pointed out the fallacies of the old methods, and suggested new means of interrogating Nature, the scattered refugees from Scholasticism were glad to unite their forces under his banner.

We must bear in mind at the outset that Prof. Fowler approaches the editorship of the "Novum Organum," from the logical and philosophical, rather than from the scientific side. It is improbable that any one man could combine the very exhaustive knowledge of logic, literature, philosophy, and science, necessary for the complete and thorough editing of the work. The main object on the part of our author has been to show that the "Novum Organum" marks an epoch in the history of logic. At the same time he has by no means neglected the other aspects of the work. He has added copious notes, which from every point of view are admirable. It is only here and there that one detects that some of the notes relating to the scientific matters so largely discussed in the second book, were not written by a man of science. Playfair and Whewell are quoted among the older authorities, while Prof. H. G. S. Smith, Mr. Kitchin, and Prof. Clifton, have lent a willing hand in the elucidation of the more knotty points. The most recent ideas on scientific subjects are introduced: such as the kinetic theory of heat, and the conservation of energy. The liquefaction of oxygen and hydrogen is noticed, although much of the work must have been in type when these discoveries were made. Altogether we have no fault to find with the treatment of the work from a scientific point of view.

There have been wide differences of opinion concerning Bacon's influence on the rise and progress of physical science. While Voltaire and the Encyclopedists on the

one side call Bacon "the father of experimental philosophy," Sir D. Brewster asserts that he had no influence whatsoever on the development of our modern experimental method. As to the most recent attacks—those of Liebig and Tchihatchef—they are based on such a very shallow acquaintance with Bacon's works, and are couched in such a pitiful and contemptible spirit, that they are quite unworthy of notice. The true estimate of Bacon's influence on modern science is no doubt to be found between the extremes of the Encyclopedists on the one hand, and of Brewster on the other. Bacon certainly was not the father of experimental philosophy, but most surely he had much to do with our modern scientific method.

Prof. Fowler discusses the nature of Bacon's influence on the progress of science, under nine separate headings. (1) "He called men, as with a voice of a herald, to lay themselves alongside of nature, to study her ways, and imitate her processes. . . . In one word he popularised science." (2) "He insisted, both by example and precept, on the importance of experiment as well as observation." (3) He thus recalled men to the study of facts; and (4) in order to do this it was necessary to free them from the subjection to authority, to which they had so long submitted. "Nor can I doubt," says our author, "that his utterances on this subject had far more influence in producing the intellectual revolution which followed than the utterances of any one of his predecessors, or perhaps than those of all taken together." (5) "The emancipation of reason from the bewitching enchantments of imagination," which he effected (6) by asserting the claims of "a logic of induction which shall do for the premisses, what the old logic, the logic of deduction, does for the conclusions." (7) "The manner in which he insisted on the subordination of scientific inquiries to practical aims, the furtherance of man's estate, and the increase of his command over the comforts and conveniences of life." (8) The "hopefulness" of Bacon, as regards the future of the human race; and finally (9) "the marvellous language in which Bacon often clothes his thoughts."

Taken in connection with all this, the charges which have been brought against Bacon, as a man of science, appear very trivial. It is urged against him that he did not accept the Copernican theory, and that it was fully accepted more than fifty years before the "Novum Organum" was written; but we must remember that the system was by no means firmly established before the discovery of the satellites of Jupiter in 1609. Prof. Fowler remarks that "it is possible to draw up a long list of eminent men, astronomers and others, anterior to, or contemporary with, Bacon, who adopted and taught the Copernican theory; but we believe there were only ten Copernicans in the world, when the "Novum Organum" began to be written. Moreover, we must remember that the anti-Copernicans could boast the great name of Tycho Brahé, while Riccioli, five-and-twenty years after Bacon's death, pretended in his "Almagestum Novum" to refute fifty-seven arguments in favour of the theory. It has also been urged that Bacon did not fully recognise the value of the discoveries of Galileo. Liebig boldly tells us that he was ignorant of the discoveries of Jupiter's satellites, of the ring of Saturn, of mountains in the moon, of the law of the motion of planets, and of the spots of the sun, while in the 39th Aphorism of Book 2 of the "Novum Organum," we read "Secundi generis sunt illa altera perspicilla quæ memorabili conatu adinvenit Galilæus; quorum ope, tanquam perscaphas aut naviculas aperiri et exerceri possint propiora cum cælestibus commercia. Hinc enim constat, galaxiam esse nodum sine coacerrationum stellarum parvarum, plane numeratarum et distinctarum; de qua re apud antiquos tantum suspicio fuit. Hinc demonstrare videtur, quod spatia orbium (quos vocant) planetarum non sint plane vacua aliis stellis, sed quod cœlum incipiat stellescere antequam ad cœlum ipsum stellarum ventum sit; licet stellis minoribus quam ut sine perspicillis istis conspici possint. Hinc choreas illas stellarum parvarum circa planetam Jovis (unde conjici possit esse in motibus stellarum plura centra) intueri licet. Hinc inæqualitates luminosi et opaci in luna distinctius cernuntur et locantur; adeo ut fieri possit quædam seleno-graphia. Hinc maculæ in sole, et id genus: omnia certe inventa nobilia, quatenus fides hujusmodi demonstrationibus tuto adhiberi possit."

If we compare Bacon's writings solely as regards their scientific aspect with those of the greater number of his contemporaries, we find a decided balance in favour of the former; at the same time it must be admitted that men like Gilbert and Galileo were far in advance of our philosopher, both as experimentalists and as discoverers Among Bacon's experimental achievements we may mention, however, the experiment which simultaneously proved the slight compressibility of water, and the porosity of the densest solids, usually alluded to as "the celebrated experiment of the Florentine academicians." Bacon made use of a sphere of lead filled with water, while the Florentines employed a sphere of silver, but this was the only difference. Bacon's experiment was tried more than thirty years before the establishment of the Accademia del Cimento, and was published ("Nov. Org.," lib. ii. aph. 45) nearly fifty years before Megalotti, the secretary of the Academy, made it known in the "Saggi di Esperienze." Mr. Ellis speaks of this as "perhaps the most remarkable of Bacon's experiments."

We may also mention that Bacon endeavoured (we believe for the first time) to determine the relationship between the volume of a vapour and that of the liquid producing it ("Nov. Org.," lib. 2, aph. 40; also the tractate, "Phenomena Universi"). Furthermore, he determined the specific gravity of seventy-three substances, taking gold as the standard. It is true that the method was clumsy, but the table was, at least, far more extensive than that of any previous writer.

In the "Historia Soni et Auditus" Bacon suggests the method for determining the velocity of sound which was employed with so much success by the French nearly two centuries later; and in the same treatise he compares "visibles and audibles" with great acuteness. Again, in the second book of the "Novum Organum," the inquiry into the nature of heat often displays, not only great observational powers, but an elegant application of logical inference.

All this, and much more, Prof. Fowler has pointed out in his exhaustive notes. His work has been, to a great extent, a labour of love; he has bestowed upon it an infinite amount of care and pains, and he has been unwearied in his endeavours to sift everything to the

bottom, and in giving an opinion to act as a just judge; moreover, he has brought to bear upon every part of it his own logical habit of mind. It will be welcomed as a valuable addition to Baconian literature, and to the history alike of philosophy, literature, logic, and science.

G. F. RODWELL

THE AMERICAN CYCLOPÆDIA

The American Cyclopædia: a Popular Dictionary of General Knowledge. Edited by George Ripley and Charles A. Dana. 17 vols. (New York and London: Appleton and Co., 1873-1878.)

IT was not to be expected that so eminently practical a nation as the United States would be long behind the stereotyped peoples of Europe in so indispensable an article as an encyclopædia. It is indeed many years since such a work was published in the States, and that so recently completed by the enterprising firm of Appleton is really a new edition of what some of our readers may remember as "The New American Cyclopædia." On the very surface the present issue is a vast improvement on the old, with its black funereal covers and unpleasant type. Indeed, the present edition may be regarded as really a new work, brought up to date in all departments. Ten years had elapsed between the completion of the old edition and the commencement of the new, and between 1863 and 1873, advances of vast importance had been made in nearly all departments of science. That Messrs. Appleton made competent provision to take account of these advances is evident from the list of men whose services they were able to obtain in bringing out the new edition. Besides the editors-in-chief, Messrs. Ripley and Dana, and four "associate editors," there was a large staff or "revisers," and a "corps" of contributors containing most of the well-known scientific workers of the States. The organisation of the work of the new edition appears to have been excellent, and from a description of the extensive premises devoted to the staff, it seems to have been a British Museum in miniature, with greatly improved arrangements.

The "American Cyclopædia" can scarcely be compared with any existing Cyclopædia in this country. It is not on so extensive a scale as the "Britannica," but is considerably larger than "Chambers'." It is indeed a kind of compromise between these two well-known works of reference; the information is not so conglomerated into huge articles as in the former, nor is it quite so subdivided as the latter—a feature which renders the latter so satisfactory from a purely "reference" standpoint. The "American" has, however, on the whole, stronger affinities with "Chambers'" than with any other; for while there are longish articles on some of the leading departments, still as a rule the great subjects are broken up into their subdivisions. Thus the article "NATURAL PHILOSOPHY" is little more than a reference to the various departments included under the wide term; under "CHEMISTRY" some of the main principles and data of the science are given, with copious references to subordinate heads. Some of these latter, in the two great divisions of physical science, are treated at considerable length, as AFFINITY, ATOMIC THEORY, HEAT, LIGHT, MAGNETISM, and so on, the last-mentioned having been written by the late Joseph Henry. GEOLOGY is a moderate-sized article by Sterry Hunt, and BOTANY is rather short, with, however, a good bibliography appended; the author's name is not given. Prof. Cleveland Abbe contributes a model article on METEOROLOGY, and many kindred subjects are written by the same able hand. One feature which the "American" has in common with "Chambers'" is the giving biographies of living men, a feature the advisability of which we do not care to discuss. Happily the "American" confines itself mainly to a statement of facts in the life and work of living men; eminence in any direction is sufficient to gain admission to these pages, and all sorts of names will be found therein, from "Boss" Tweed to Charles Darwin.

The geography in this new edition is specially well done, one of the largest and best articles in the work being that on the United States. Japan is well done by Prof. Griffis of Tokio, the language being by Dr. Hepburn, of Tokio, and the literature by Mr. Satow, our Secretary of Legation there. We are glad to find that in most cases where it is desirable, satisfactory bibliographies are appended to the articles. Perhaps one of the most distinctive features of the Cyclopædia is the copious index, occupying the whole of the seventeenth volume, which has been prepared for the whole work. This, indeed, doubles the value of the Cyclopædia as a book of reference. Although, as we have said, the great subjects are, as a rule, subdivided into their leading branches, still, throughout the greater number of articles are incidental references containing scraps of valuable information which can find no place of their own. In this way much useful knowledge would be buried but for a good index, and the index prepared for the "American" by Dr. Conant, is one of the most thorough and best planned we have seen. It covers 800 pages, is simple in its method, easily consulted, and admirably adapted not only to bring out all that is in the work, but to enable any one who might desire it, to follow out any subject to completeness. The bold clear type in which the index is printed adds greatly to its usefulness, and, altogether, it is a feature which those who are in the habit of consulting cyclopædias in earnest will know how to value.

The maps and illustrations in the "American" are, on the whole, faithful and good, and ample in quantity, and the type and paper are excellent. In short, in all the features distinctive of a cyclopædia the "American" will hold its own with any in the Old World. It would no doubt be possible to pick faults in plan and criticise some of the particular articles, but this we are not disposed to do where the work as a whole is so eminently satisfactory. The only objection we feel inclined to make is to the price. The volumes are almost the same size as those of "Chambers'," but each is more than double in price, and not very much less than the price of a volume of the "Britannica." This may have been rendered necessary by the great expenses of preparation, but we doubt if at such a price it would command any great sale here. We are surprised to find that the work is sold, not through the regular "trade," but by what is known here as the "canvassing" system. We should have thought that so high-class a work would not have had to depend on any such system for sale. Of course the articles are mainly